

SEQUENCE LISTING

<110> Hanke, Paul D.
Li D'Elia, Lhing Yew
Rayapati, John
Crafton, Corey
Walsh, Holly

<120> Increased Lysine Production by Gene Amplification

<130> 1533.1030002

<140> 09/722,441

<141> 2000 11 28

<150> US 60/173,707
<151> 1999-12-30

<150> US 60/184,130
<151> 2000-02-22

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<170> PatentIn version 3.0

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<221> CDS

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Ser Asp Lys Pro Gly Glu Ala Ala Lys Val Phe Arg Ala Leu Ala Asp	
275 280 285	
gca gaa atc aac att gac atg gtt ctg cag aac gtc tcc tct gtg gaa	912
Ala Glu Ile Asn Ile Asp Met Val Leu Gln Asn Val Ser Ser Val Glu	
290 295 300	
gac ggc acc acc gac atc acg ttc acc tgc cct cgc gct gac gga cgc	960
Asp Gly Thr Thr Asp Ile Thr Phe Thr Cys Pro Arg Ala Asp Gly Arg	
305 310 315 320	
cgt gcg atg gag atc ttg aag aag ctt cag gtt cag ggc aac tgg acc	1008
Arg Ala Met Glu Ile Leu Lys Lys Leu Gln Val Gln Gly Asn Trp Thr	
325 330 335	
aat gtg ctt tac gac gac cag gtc ggc aaa gtc tcc ctc gtg ggt gct	1056
Asn Val Leu Tyr Asp Asp Gln Val Gly Lys Val Ser Leu Val Gly Ala	
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ggc atg aag tct cac cca ggt gtt acc gca gag ttc atg gaa gct ctg	1104
Gly Met Lys Ser His Pro Gly Val Thr Ala Glu Phe Met Glu Ala Leu	
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cgc gat gtc aac gtg aac atc gaa ttg att tcc atc tct gag atc cgc	1152
Arg Asp Val Asn Val Asn Ile Glu Leu Ile Ser Ile Ser Glu Ile Arg	
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Ile Ser Val Leu Ile Arg Glu Asp Asp Leu Asp Ala Ala Ala Arg Ala	
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<213> Corynebacterium glutamicum

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Val	Ala	Met	Ala	Ile	Glu	Ser	Leu	Gly	Ala	Glu	Ala	Gln	Ser	Phe	Thr
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Leu	Ala	Ala	Ala	Leu	Asn	Ala	Asp	Val	Cys	Glu	Ile	Tyr	Ser	Asp	Val
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Asp	Gly	Val	Tyr	Thr	Ala	Asp	Pro	Arg	Ile	Val	Pro	Asn	Ala	Gln	Lys
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Leu	Glu	Lys	Leu	Ser	Phe	Glu	Glu	Met	Leu	Glu	Leu	Ala	Ala	Val	Gly
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Ile	Ser	Val	Leu	Ile	Arg	Glu	Asp	Asp	Leu	Asp	Ala	Ala	Ala	Arg	Ala
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Leu	His	Glu	Gln	Phe	Gln	Leu	Gly	Gly	Glu	Asp	Glu	Ala	Val	Val	Tyr
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<213> Corynebacterium glutamicum

<220>

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<222> (1)..(1035)

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Phe	Phe	Ala	Ser	Pro	Arg	Ser	Ala	Gly	Arg	Lys	Ile	Glu	Phe	Arg	Gly	
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acg	gaa	atc	gag	gta	gaa	gac	att	act	cag	gca	acc	gag	gag	tcc	ctc	192
Thr	Glu	Ile	Glu	Val	Glu	Asp	Ile	Thr	Gln	Ala	Thr	Glu	Glu	Ser	Leu	
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aag	ggc	atc	gac	gtt	gcg	ttg	ttc	tct	gct	gga	ggc	acc	gct	tcc	aag	240
Lys	Gly	Ile	Asp	Val	Ala	Leu	Phe	Ser	Ala	Gly	Gly	Thr	Ala	Ser	Lys	
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cag	tac	gct	cca	ctg	ttt	gct	gct	gca	ggc	gcg	act	gtt	gtg	gat	aac	288
Gln	Tyr	Ala	Pro	Leu	Phe	Ala	Ala	Ala	Gly	Ala	Thr	Val	Val	Asp	Asn	
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tct	tct	gct	tgg	cgc	aag	gac	gac	gag	gtt	cca	cta	atc	gtc	tct	gag	336
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Val	Asn	Pro	Ser	Asp	Lys	Asp	Ser	Leu	Val	Lys	Gly	Ile	Ile	Ala	Asn	
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Pro	Asn	Cys	Thr	Thr	Met	Ala	Ala	Met	Pro	Val	Leu	Lys	Pro	Leu	His	
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Ser	Gly	Ser	Gly	Leu	Ala	Gly	Val	Glu	Thr	Leu	Ala	Lys	Gln	Val	Ala	
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Ala	Val	Gly	Asp	His	Asn	Val	Glu	Phe	Val	His	Asp	Gly	Gln	Ala	Ala	
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gac	gca	ggc	gat	gtc	gga	cct	tac	gtt	tcc	cca	atc	gct	tac	aac	gtg	624
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Leu	Pro	Phe	Ala	Gly	Asn	Leu	Val	Asp	Asp	Gly	Thr	Phe	Glu	Thr	Asp	
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	225				230					235					240	
gac	ctc	aag	gtc	tca	ggc	acc	tgc	gtc	cgc	gtg	ccg	gtt	ttc	acc	ggc	768
Asp	Leu	Lys	Val	Ser	Gly	Thr	Cys	Val	Arg	Val	Pro	Val	Phe	Thr	Gly	
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cac	acg	ctg	acc	att	cac	gcc	gaa	ttc	gac	aag	gca	atc	acc	gtc	gag	816
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Val Pro Thr Pro Leu Ala Ala Ala Gly Ile Asp Glu Ser Leu Val Gly	
290 295 300	

cgc atc cgt cag gac tcc act gtc gac gac aac cgc ggt ctg gtt ctc	960
Arg Ile Arg Gln Asp Ser Thr Val Asp Asp Asn Arg Gly Leu Val Leu	
305 310 315 320	

gtc gta tct ggc gat aac ctt cgc aag ggc gca gca ctg aac acc att	1008
Val Val Ser Gly Asp Asn Leu Arg Lys Gly Ala Ala Leu Asn Thr Ile	
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<213> Corynebacterium glutamicum

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Lys Gly Ile Asp Val Ala Leu Phe Ser Ala Gly Gly Thr Ala Ser Lys
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Gln Tyr Ala Pro Leu Phe Ala Ala Ala Gly Ala Thr Val Val Asp Asn
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Ala	Val	Gly	Asp	His	Asn	Val	Glu	Phe	Val	His	Asp	Gly	Gln	Ala	Ala
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Asp	Ala	Gly	Asp	Val	Gly	Pro	Tyr	Val	Ser	Pro	Ile	Ala	Tyr	Asn	Val
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Leu	Pro	Phe	Ala	Gly	Asn	Leu	Val	Asp	Asp	Gly	Thr	Phe	Glu	Thr	Asp
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Glu	Glu	Gln	Lys	Leu	Arg	Asn	Glu	Ser	Arg	Lys	Ile	Leu	Gly	Leu	Pro
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Asp	Leu	Lys	Val	Ser	Gly	Thr	Cys	Val	Arg	Val	Pro	Val	Phe	Thr	Gly
				245					250					255	
His	Thr	Leu	Thr	Ile	His	Ala	Glu	Phe	Asp	Lys	Ala	Ile	Thr	Val	Glu
			260					265					270		
Gln	Ala	Gln	Glu	Ile	Leu	Gly	Ala	Ala	Ser	Gly	Val	Glu	Leu	Val	Asp
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atc gct gct ggc cgc gaa gtc gcg gct tat ttg gtt gat aag ggc ttg	144
Ile Ala Ala Gly Arg Glu Val Ala Ala Tyr Leu Val Asp Lys Gly Leu	
35 40 45	

gat tct ttg gtt ctc gcg ggc acc act ggt gaa tcc cca acg aca acc	192
Asp Ser Leu Val Leu Ala Gly Thr Thr Gly Glu Ser Pro Thr Thr Thr	
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gcc gct gaa aaa cta gaa ctg ctc aag gcc gtt cgt gag gaa gtt ggg	240
Ala Ala Glu Lys Leu Glu Leu Leu Lys Ala Val Arg Glu Glu Val Gly	
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Asp Arg Ala Lys Leu Ile Ala Gly Val Gly Thr Asn Asn Thr Arg Thr	
85 90 95	

tct gtg gaa ctt gcg gaa gct gct gct tct gct ggc gca gac ggc ctt	336
Ser Val Glu Leu Ala Glu Ala Ala Ala Ser Ala Gly Ala Asp Gly Leu	
100 105 110	

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115 120 125	

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130 135 140	

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Tyr Asp Ile Pro Gly Arg Ser Gly Ile Pro Ile Glu Ser Asp Thr Met	
145 150 155 160	

aga cgc ctg agt gaa tta cct acg att ttg gcg gtc aag gac gcc aag	528
Arg Arg Leu Ser Glu Leu Pro Thr Ile Leu Ala Val Lys Asp Ala Lys	
165 170 175	

ggt gac ctc gtt gca gcc acg tca ttg atc aaa gaa acg gga ctt gcc	576
Gly Asp Leu Val Ala Ala Thr Ser Leu Ile Lys Glu Thr Gly Leu Ala	
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Gly	Gly	Val	Ser	Leu	Ala	Lys	Ala	Ala	Leu	Arg	Leu	Gln	Gly	Ile	Asn		
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gta	gga	gat	cct	cga	ctt	cca	att	atg	gct	cca	aat	gag	cag	gaa	ctt	864	
Val	Gly	Asp	Pro	Arg	Leu	Pro	Ile	Met	Ala	Pro	Asn	Glu	Gln	Glu	Leu		
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gag	gct	ctc	cga	gaa	gac	atg	aaa	aaa	gct	gga	gtt	cta	taa			906	
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<213> Corynebacterium glutamicum

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Ile	Ala	Ala	Gly	Arg	Glu	Val	Ala	Ala	Tyr	Leu	Val	Asp	Lys	Gly	Leu		
		35					40					45					
Asp	Ser	Leu	Val	Leu	Ala	Gly	Thr	Thr	Gly	Glu	Ser	Pro	Thr	Thr	Thr		
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Ala	Ala	Glu	Lys	Leu	Glu	Leu	Leu	Lys	Ala	Val	Arg	Glu	Glu	Val	Gly		
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Asp	Arg	Ala	Lys	Leu	Ile	Ala	Gly	Val	Gly	Thr	Asn	Asn	Thr	Arg	Thr		
				85					90					95			

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 115 120 125
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 130 135 140
 Tyr Asp Ile Pro Gly Arg Ser Gly Ile Pro Ile Glu Ser Asp Thr Met
 145 150 155 160
 Arg Arg Leu Ser Glu Leu Pro Thr Ile Leu Ala Val Lys Asp Ala Lys
 165 170 175
 Gly Asp Leu Val Ala Ala Thr Ser Leu Ile Lys Glu Thr Gly Leu Ala
 180 185 190
 Trp Tyr Ser Gly Asp Asp Pro Leu Asn Leu Val Trp Leu Ala Leu Gly
 195 200 205
 Gly Ser Gly Phe Ile Ser Val Ile Gly His Ala Ala Pro Thr Ala Leu
 210 215 220
 Arg Glu Leu Tyr Thr Ser Phe Glu Glu Gly Asp Leu Val Arg Ala Arg
 225 230 235 240
 Glu Ile Asn Ala Lys Leu Ser Pro Leu Val Ala Ala Gln Gly Arg Leu
 245 250 255
 Gly Gly Val Ser Leu Ala Lys Ala Ala Leu Arg Leu Gln Gly Ile Asn
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<212> DNA

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act att gtg gca gca gtc aat gag tcc gac gat ctg gag ctt gtt gca	96
Thr Ile Val Ala Ala Val Asn Glu Ser Asp Asp Leu Glu Leu Val Ala	
20 25 30	
gag atc ggc gtc gac gat gat ttg agc ctt ctg gta gac aac ggc gct	144
Glu Ile Gly Val Asp Asp Asp Leu Ser Leu Leu Val Asp Asn Gly Ala	
35 40 45	
gaa gtt gtc gtt gac ttc acc act cct aac gct gtg atg ggc aac ctg	192
Glu Val Val Val Asp Phe Thr Thr Pro Asn Ala Val Met Gly Asn Leu	
50 55 60	
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Glu Phe Cys Ile Asn Asn Gly Ile Ser Ala Val Val Gly Thr Thr Gly	
65 70 75 80	
ttc gat aat gct cgt ttg gag cag gtt cgc gcc tgg ctt gaa gga aaa	288
Phe Asp Asn Ala Arg Leu Glu Gln Val Arg Ala Trp Leu Glu Gly Lys	
85 90 95	
gac aat gtc ggt gtt ctg atc gca cct aac ttt gct atc tct gcg gtg	336
Asp Asn Val Gly Val Leu Ile Ala Pro Asn Phe Ala Ile Ser Ala Val	
100 105 110	
ttg acc atg gtc ttt tcc aag cag gct gcc cgc ttc ttc gaa tca gct	384
Leu Thr Met Val Phe Ser Lys Gln Ala Ala Arg Phe Phe Glu Ser Ala	
115 120 125	
gaa gtt att gag ctg cac cac ccc aac aag ctg gat gca cct tca ggc	432
Glu Val Ile Glu Leu His His Pro Asn Lys Leu Asp Ala Pro Ser Gly	
130 135 140	
acc gcg atc cac act gct cag ggc att gct gcg gca cgc aaa gaa gca	480
Thr Ala Ile His Thr Ala Gln Gly Ile Ala Ala Ala Arg Lys Glu Ala	
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Gly Met Asp Ala Gln Pro Asp Ala Thr Glu Gln Ala Leu Glu Gly Ser	
165 170 175	
cgt ggc gca agc gta gat gga atc cca gtt cac gca gtc cgc atg tcc	576
Arg Gly Ala Ser Val Asp Gly Ile Pro Val His Ala Val Arg Met Ser	
180 185 190	
ggc atg gtt gct cac gag caa gtt atc ttt ggc acc cag ggt cag acc	624
Gly Met Val Ala His Glu Gln Val Ile Phe Gly Thr Gln Gly Gln Thr	
195 200 205	
ttg acc atc aag cag gac tcc tat gat cgc aac tca ttt gca cca ggt	672
Leu Thr Ile Lys Gln Asp tcc Tyr Asp Arg Asn Ser Phe Ala Pro Gly	
210 215 220	

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Val	Leu	Val	Gly	Val	Arg	Asn	Ile	Ala	Gln	His	Pro	Gly	Leu	Val	Val	
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Gly	Leu	Glu	His	Tyr	Leu	Gly	Leu									
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<212> PRT

<213> Corynebacterium glutamicum

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Glu	Ile	Gly	Val	Asp	Asp	Asp	Leu	Ser	Leu	Leu	Val	Asp	Asn	Gly	Ala	
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Glu	Phe	Cys	Ile	Asn	Asn	Gly	Ile	Ser	Ala	Val	Val	Gly	Thr	Thr	Gly	
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Phe	Asp	Asn	Ala	Arg	Leu	Glu	Gln	Val	Arg	Ala	Trp	Leu	Glu	Gly	Lys	
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Asp	Asn	Val	Gly	Val	Leu	Ile	Ala	Pro	Asn	Phe	Ala	Ile	Ser	Ala	Val	
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Leu	Thr	Met	Val	Phe	Ser	Lys	Gln	Ala	Ala	Arg	Phe	Phe	Glu	Ser	Ala	
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Glu	Val	Ile	Glu	Leu	His	His	Pro	Asn	Lys	Leu	Asp	Ala	Pro	Ser	Gly	
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Thr	Ala	Ile	His	Thr	Ala	Gln	Gly	Ile	Ala	Ala	Ala	Arg	Lys	Glu	Ala	
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Gly	Met	Asp	Ala	Gln	Pro	Asp	Ala	Thr	Glu	Gln	Ala	Leu	Glu	Gly	Ser	

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Arg	Gly	Ala	Ser 180	Val	Asp	Gly	Ile	Pro 185	Val	His	Ala	Val	Arg 190	Met	Ser
Gly	Met	Val 195	Ala	His	Glu	Gln	Val 200	Ile	Phe	Gly	Thr	Gln 205	Gly	Gln	Thr
Leu	Thr 210	Ile	Lys	Gln	Asp	Ser 215	Tyr	Asp	Arg	Asn	Ser 220	Phe	Ala	Pro	Gly
Val 225	Leu	Val	Gly	Val	Arg 230	Asn	Ile	Ala	Gln	His 235	Pro	Gly	Leu	Val	Val 240
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Asp	Tyr	Lys	Asn	Met	Thr	Asn	Ile	Arg	Val	Ala	Ile	Val	Gly	Tyr	Gly		
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Asn	Leu	Gly	Arg	Ser	Val	Glu	Lys	Leu	Ile	Ala	Lys	Gln	Pro	Asp	Met		
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Asp	Leu	Val	Gly	Ile	Phe	Ser	Arg	Arg	Ala	Thr	Leu	Asp	Thr	Lys	Thr		
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cca	gtc	ttt	gat	gtc	gcc	gac	gtg	gac	aag	cac	gcc	gac	gac	gtg	gac	240	
Pro	Val	Phe	Asp	Val	Ala	Asp	Val	Asp	Lys	His	Ala	Asp	Asp	Val	Asp		
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gtg	ctg	ttc	ctg	tgc	atg	ggc	tcc	gcc	acc	gac	atc	cct	gaq	caq	qca	288	

Val	Leu	Phe	Leu	Cys 85	Met	Gly	Ser	Ala	Thr 90	Asp	Ile	Pro	Glu	Gln 95	Ala		
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Pro	Lys	Phe	Ala 100	Gln	Phe	Ala	Cys	Thr 105	Val	Asp	Thr	Tyr	Asp 110	Asn	His		
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Arg	Asp	Ile 115	Pro	Arg	His	Arg	Gln 120	Val	Met	Asn	Glu	Ala 125	Ala	Thr	Ala		
gcc	ggc	aac	gtt	gca	ctg	gtc	tct	acc	ggc	tgg	gat	cca	gga	atg	ttc		432
Ala	Gly 130	Asn	Val	Ala	Leu	Val 135	Ser	Thr	Gly	Trp	Asp 140	Pro	Gly	Met	Phe		
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Ser 145	Ile	Asn	Arg	Val	Tyr 150	Ala	Ala	Ala	Val	Leu 155	Ala	Glu	His	Gln 160	Gln		
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His	Thr	Phe	Trp	Gly 165	Pro	Gly	Leu	Ser	Gln 170	Gly	His	Ser	Asp	Ala 175	Leu		
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Arg	Arg	Ile 180	Pro	Gly	Val	Gln	Lys	Ala 185	Val	Gln	Tyr	Thr	Leu 190	Pro	Ser		
gaa	gaa	gcc	ctg	gaa	aag	gcc	cgc	cgt	ggc	gaa	gcc	ggc	gac	ctc	acc		624
Glu	Glu	Ala 195	Leu	Glu	Lys	Ala	Arg 200	Arg	Gly	Glu	Ala	Gly 205	Asp	Leu	Thr		
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Gly	Lys 210	Gln	Thr	His	Lys	Arg 215	Gln	Cys	Phe	Val	Ala 220	Ala	Asp	Ala	Ala		
gac	cac	gag	cgc	atc	gaa	aac	gac	atc	cgc	acc	atg	cct	gat	tac	ttc		720
Asp 225	His	Glu	Arg	Ile 230	Glu	Asn	Asp	Ile	Arg	Thr 235	Met	Pro	Asp	Tyr 240	Phe		
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Val	Gly	Tyr	Glu 245	Val	Glu	Val	Asn	Phe	Ile 250	Asp	Glu	Ala	Thr	Leu 255	Asp		
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Ala	Glu	His 260	Thr	Gly	Met	Pro	His	Gly 265	Gly	His	Val	Ile 270	Thr	Thr	Gly		
gac	acc	ggc	ggc	ttc	aac	cac	acc	gtg	gaa	tac	atc	ctg	aag	ctg	gac		864
Asp	Thr 275	Gly	Gly	Phe	Asn	His	Thr 280	Val	Glu	Tyr	Ile 285	Leu	Lys	Leu	Asp		
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Arg	Asn 290	Pro	Asp	Phe	Thr	Ala 295	Ser	Ser	Gln	Ile	Ala 300	Phe	Gly	Arg	Ala		
gct	cac	cgc	atg	aag	cag	cag	ggc	caa	agc	ggc	gct	ttc	acc	gtc	ctc		960
Ala	His	Arg	Met	Lys 310	Gln	Gln	Gly	Gln	Ser	Gly 315	Ala	Phe	Thr	Val 320	Leu		
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Glu	Val	Ala	Pro	Tyr 325	Leu	Leu	Ser	Pro	Glu 330	Asn	Leu	Asp	Asp	Leu 335	Ile		

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1023

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<213> Corynebacterium glutamicum

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 20 25 30

Asn Leu Gly Arg Ser Val Glu Lys Leu Ile Ala Lys Gln Pro Asp Met
 35 40 45

Asp Leu Val Gly Ile Phe Ser Arg Arg Ala Thr Leu Asp Thr Lys Thr
 50 55 60

Pro Val Phe Asp Val Ala Asp Val Asp Lys His Ala Asp Asp Val Asp
 65 70 75 80

Val Leu Phe Leu Cys Met Gly Ser Ala Thr Asp Ile Pro Glu Gln Ala
 85 90 95

Pro Lys Phe Ala Gln Phe Ala Cys Thr Val Asp Thr Tyr Asp Asn His
 100 105 110

Arg Asp Ile Pro Arg His Arg Gln Val Met Asn Glu Ala Ala Thr Ala
 115 120 125

Ala Gly Asn Val Ala Leu Val Ser Thr Gly Trp Asp Pro Gly Met Phe
 130 135 140

Ser Ile Asn Arg Val Tyr Ala Ala Ala Val Leu Ala Glu His Gln Gln
 145 150 155 160

His Thr Phe Trp Gly Pro Gly Leu Ser Gln Gly His Ser Asp Ala Leu
 165 170 175

Arg Arg Ile Pro Gly Val Gln Lys Ala Val Gln Tyr Thr Leu Pro Ser
 180 185 190

Glu Glu Ala Leu Glu Lys Ala Arg Arg Gly Glu Ala Gly Asp Leu Thr
 195 200 205
 Gly Lys Gln Thr His Lys Arg Gln Cys Phe Val Val Ala Asp Ala Ala
 210 215 220
 Asp His Glu Arg Ile Glu Asn Asp Ile Arg Thr Met Pro Asp Tyr Phe
 225 230 235 240
 Val Gly Tyr Glu Val Glu Val Asn Phe Ile Asp Glu Ala Thr Leu Asp
 245 250 255
 Ala Glu His Thr Gly Met Pro His Gly Gly His Val Ile Thr Thr Gly
 260 265 270
 Asp Thr Gly Gly Phe Asn His Thr Val Glu Tyr Ile Leu Lys Leu Asp
 275 280 285
 Arg Asn Pro Asp Phe Thr Ala Ser Ser Gln Ile Ala Phe Gly Arg Ala
 290 295 300
 Ala His Arg Met Lys Gln Gln Gly Gln Ser Gly Ala Phe Thr Val Leu
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<213> *Corynebacterium glutamicum*

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cct Pro	ctg Leu	cct Pro	gac Asp	ctc Leu	gct Ala	gaa Glu	gaa Glu	tac Tyr	gga Gly	acc Thr	cca Pro	ctg Leu	ttc Phe	gta Val	gtc Val	144	
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ggg Gly	gga Gly	cca Pro	ggc Gly	aat Asn	gtg Val	cac His	tac Tyr	gca Ala	tcc Ser	aaa Lys	gcg Ala	ttc Phe	ctg Leu	acc Thr	aag Lys	240	
acc Thr	att Ile	gca Ala	cgt Arg	tgg Trp	gtt Val	gat Asp	gaa Glu	gag Glu	ggg Gly	ctg Leu	gca Ala	ctg Leu	gac Asp	att Ile	gcg Ala	288	
tcc Ser	atc Ile	aat Asn	gaa Glu	ctg Leu	ggc Gly	att Ile	gcc Ala	ctg Leu	gcc Ala	gct Ala	ggg Gly	ttc Phe	ccg Pro	gcc Ala	agc Ser	336	
cgt Arg	atc Ile	acc Thr	gcg Ala	cac His	ggc Gly	aac Asn	aac Asn	aaa Lys	ggc Gly	gta Val	gag Glu	ttc Phe	ctg Leu	cgc Arg	gcg Ala	384	
ttg Leu	gtt Val	caa Gln	aac Asn	ggg Gly	gtc Val	ggg Gly	cat His	gtg Val	gtg Val	ctg Leu	gac Asp	tcc Ser	gcg Ala	cag Gln	gaa Glu	432	
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atc Ile	cac His	agc Ser	gaa Glu	cta Leu	ggg Gly	gtc Val	gcc Ala	ctt Leu	cct Pro	gag Glu	ctg Leu	gac Asp	ctc Leu	ggg Gly	ggc Gly	768	
gga Glu	tac Leu	ggc Val	atc Ile	gcc Ala	tac Val	act Glu	gca Ala	gat Val	gag Glu	gaa Glu	cca Ala	ctc Ala	aac Glu	gtc Ala	gca Ala	816	

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Glu	Val	Ala	Ser	Asp	Leu	Leu	Thr	Ala	Val	Gly	Lys	Met	Ala	Ala	Glu		
		275					280					285					
cta	ggc	atc	gac	gca	cca	acc	gtg	ctt	gtt	gag	ccc	ggc	cgc	gct	atc	912	
Leu	Gly	Ile	Asp	Ala	Pro	Thr	Val	Leu	Val	Glu	Pro	Gly	Arg	Ala	Ile		
	290					295					300						
gca	ggc	ccc	tcc	acc	gtg	acc	atc	tac	gaa	gtc	ggc	acc	acc	aaa	aac	960	
Ala	Gly	Pro	Ser	Thr	Val	Thr	Ile	Tyr	Glu	Val	Gly	Thr	Thr	Lys	Asn		
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gtc	cac	gta	gac	gac	gac	aaa	acc	cgc	cgc	tac	gta	gcc	gtc	gac	gga	1008	
Val	His	Val	Asp	Asp	Asp	Lys	Thr	Arg	Arg	Tyr	Val	Ala	Val	Asp	Gly		
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ggc	atg	tcc	gac	aac	atc	cgc	cca	gca	ctc	tac	ggc	tcc	gaa	tac	gac	1056	
Gly	Met	Ser	Asp	Asn	Ile	Arg	Pro	Ala	Leu	Tyr	Gly	Ser	Glu	Tyr	Asp		
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gcc	cgc	gta	gta	tcc	cgc	ttc	gcc	gaa	gga	gac	cca	gta	agc	acc	cgc	1104	
Ala	Arg	Val	Val	Ser	Arg	Phe	Ala	Glu	Gly	Asp	Pro	Val	Ser	Thr	Arg		
		355					360					365					
atc	gtg	ggc	tcc	cac	tgc	gaa	tcc	ggc	gat	atc	ctg	atc	aac	gat	gaa	1152	
Ile	Val	Gly	Ser	His	Cys	Glu	Ser	Gly	Asp	Ile	Leu	Ile	Asn	Asp	Glu		
	370					375					380						
atc	tac	cca	tct	gac	atc	acc	agc	ggc	gac	ttc	ctc	gca	ctc	gca	gcc	1200	
Ile	Tyr	Pro	Ser	Asp	Ile	Thr	Ser	Gly	Asp	Phe	Leu	Ala	Leu	Ala	Ala		
385					390				395						400		
acc	ggc	gca	tac	tgc	tac	gcc	atg	agc	tcc	cgc	tac	aac	gcc	ttc	aca	1248	
Thr	Gly	Ala	Tyr	Cys	Tyr	Ala	Met	Ser	Ser	Arg	Tyr	Asn	Ala	Phe	Thr		
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cgg	ccc	gcc	gtc	gtg	tcc	gtc	cgc	gct	ggc	agc	tcc	cgc	ctc	atg	ctg	1296	
Arg	Pro	Ala	Val	Val	Ser	Val	Arg	Ala	Gly	Ser	Ser	Arg	Leu	Met	Leu		
			420					425					430				
cgc	cgc	gaa	acc	ctc	gac	gac	atc	ctc	tca	cta	gag	gca	taa			1338	
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 Pro Leu Pro Asp Leu Ala Glu Glu Tyr Gly Thr Pro Leu Phe Val Val
 35 40 45
 Asp Glu Asp Asp Phe Arg Ser Arg Cys Arg Asp Met Ala Thr Ala Phe
 50 55 60
 Gly Gly Pro Gly Asn Val His Tyr Ala Ser Lys Ala Phe Leu Thr Lys
 65 70 75 80
 Thr Ile Ala Arg Trp Val Asp Glu Glu Gly Leu Ala Leu Asp Ile Ala
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 Ser Ile Asn Glu Leu Gly Ile Ala Leu Ala Ala Gly Phe Pro Ala Ser
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 Arg Ile Thr Ala His Gly Asn Asn Lys Gly Val Glu Phe Leu Arg Ala
 115 120 125
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 Leu Glu Leu Leu Asp Tyr Val Ala Ala Gly Glu Gly Lys Ile Gln Asp
 145 150 155 160
 Val Leu Ile Arg Val Lys Pro Gly Ile Glu Ala His Thr His Glu Phe
 165 170 175
 Ile Ala Thr Ser His Glu Asp Gln Lys Phe Gly Phe Ser Leu Ala Ser
 180 185 190
 Gly Ser Ala Phe Glu Ala Ala Lys Ala Ala Asn Asn Ala Glu Asn Leu
 195 200 205
 Asn Leu Val Gly Leu His Cys His Val Gly Ser Gln Val Phe Asp Ala
 210 215 220
 Glu Gly Phe Lys Leu Ala Ala Glu Arg Val Leu Gly Leu Tyr Ser Gln
 225 230 235 240
 Ile His Ser Glu Leu Gly Val Ala Leu Pro Glu Leu Asp Leu Gly Gly
 245 250 255
 Gly Tyr Gly Ile Ala Tyr Thr Ala Asp Glu Glu Pro Leu Asn Val Ala
 260 265 270

Glu Val Ala Ser Asp Leu Leu Thr Ala Val Gly Lys Met Ala Ala Glu
 275 280 285
 Leu Gly Ile Asp Ala Pro Thr Val Leu Val Glu Pro Gly Arg Ala Ile
 290 295 300
 Ala Gly Pro Ser Thr Val Thr Ile Tyr Glu Val Gly Thr Thr Lys Asn
 305 310 315 320
 Val His Val Asp Asp Asp Lys Thr Arg Arg Tyr Val Ala Val Asp Gly
 325 330 335
 Gly Met Ser Asp Asn Ile Arg Pro Ala Leu Tyr Gly Ser Glu Tyr Asp
 340 345 350
 Ala Arg Val Val Ser Arg Phe Ala Glu Gly Asp Pro Val Ser Thr Arg
 355 360 365
 Ile Val Gly Ser His Cys Glu Ser Gly Asp Ile Leu Ile Asn Asp Glu
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 385 390 395 400
 Thr Gly Ala Tyr Cys Tyr Ala Met Ser Ser Arg Tyr Asn Ala Phe Thr
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cgc aat gcc gtg cgc caa gaa gac ggc gtt gtc acc gtc gct ggt gtg	96																
Arg Asn Ala Val Arg Gln Glu Asp Gly Val Val Thr Val Ala Gly Val																	
20 25 30																	
cct ctg cct gac ctc gct gaa gaa tac gga acc cca ctg ttc gta gtc	144																
Pro Leu Pro Asp Leu Ala Glu Glu Tyr Gly Thr Pro Leu Phe Val Val																	
35 40 45																	
gac gag gac gat ttc cgt tcc cgc tgt cgc gac atg gct acc gca ttc	192																
Asp Glu Asp Asp Phe Arg Ser Arg Cys Arg Asp Met Ala Thr Ala Phe																	
50 55 60																	
ggt gga cca ggc aat gtg cac tac gca tct aaa gcg ttc ctg acc aag	240																
Gly Gly Pro Gly Asn Val His Tyr Ala Ser Lys Ala Phe Leu Thr Lys																	
65 70 75 80																	
acc att gca cgt tgg gtt gat gaa gag ggg ctg gca ctg gac att gca	288																
Thr Ile Ala Arg Trp Val Asp Glu Glu Gly Leu Ala Leu Asp Ile Ala																	
85 90 95																	
tcc atc aac gaa ctg ggc att gcc ctg gcc gct ggt ttc ccc gcc agc	336																
Ser Ile Asn Glu Leu Gly Ile Ala Leu Ala Ala Gly Phe Pro Ala Ser																	
100 105 110																	
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Arg Ile Thr Ala His Gly Asn Asn Lys Gly Val Glu Phe Leu Arg Ala																	
115 120 125																	
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Leu Val Gln Asn Gly Val Gly His Val Val Leu Asp Ser Ala Gln Glu																	
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Leu Glu Leu Leu Asp Tyr Val Ala Ala Gly Glu Gly Lys Ile Gln Asp																	
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165 170 175																	
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Ile Ala Thr Ser His Glu Asp Gln Lys Phe Gly Phe Ser Leu Ala Ser																	
180 185 190																	
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Gly Ser Ala Phe Glu Ala Ala Lys Ala Ala Asn Asn Ala Glu Asn Leu																	
195 200 205																	
aac ctg gtt ggc ctg cac tgc cac gtt ggt tcc cag gtg ttc gac gcc	672																
Asn Leu Val Gly Leu His Cys His Val Gly Ser Gln Val Phe Asp Ala																	
210 215 220																	
gaa ggc ttc aag ctg gca gca gaa cgc gtg ttg ggc ctg tac tca cag	720																
Glu Gly Phe Lys Leu Ala Ala Glu Arg Val Leu Gly Leu Tyr Ser Gln																	
225 230 235 240																	
atc cac agc gaa ctg ggc gtt gcc ctt cct gaa ctg gat ctc ggt ggc	768																
Ile His Ser Glu Leu Gly Val Ala Leu Pro Glu Leu Asp Leu Gly Gly																	

	245	250	255	
	gga tac ggc att gcc tat acc gca gct gaa gaa cca ctc aac gtc gca			816
	Gly Tyr Gly Ile Ala Tyr Thr Ala Ala Glu Glu Pro Leu Asn Val Ala			
	260	265	270	
	gaa gtt gcc tcc gac ctg ctc acc gca gtc gga aaa atg gca gcg gaa			864
	Glu Val Ala Ser Asp Leu Leu Thr Ala Val Gly Lys Met Ala Ala Glu			
	275	280	285	
	cta ggc atc gac gca cca acc gtg ctt gtt gag ccc ggc cgc gct atc			912
	Leu Gly Ile Asp Ala Pro Thr Val Leu Val Glu Pro Gly Arg Ala Ile			
	290	295	300	
	gca ggc ccc tcc acc gtg acc atc tac gaa gtc ggc acc acc aaa gac			960
	Ala Gly Pro Ser Thr Val Thr Ile Tyr Glu Val Gly Thr Thr Lys Asp			
	305	310	315	320
	gtc cac gta gac gac gac aaa acc cgc cgt tac atc gcc gtg gac gga			1008
	Val His Val Asp Asp Asp Lys Thr Arg Arg Tyr Ile Ala Val Asp Gly			
	325	330	335	
	ggc atg tcc gac aac atc cgc cca gca ctc tac ggc tcc gaa tac gac			1056
	Gly Met Ser Asp Asn Ile Arg Pro Ala Leu Tyr Gly Ser Glu Tyr Asp			
	340	345	350	
	gcc cgc gta gta tcc cgc ttc gcc gaa gga gac cca gta agc acc cgc			1104
	Ala Arg Val Val Ser Arg Phe Ala Glu Gly Asp Pro Val Ser Thr Arg			
	355	360	365	
	atc gtg ggc tcc cac tgc gaa tcc ggc gat atc ctg atc aac gat gaa			1152
	Ile Val Gly Ser His Cys Glu Ser Gly Asp Ile Leu Ile Asn Asp Glu			
	370	375	380	
	atc tac cca tct gac atc acc agc ggc gac ttc ctt gca ctc gca gcc			1200
	Ile Tyr Pro Ser Asp Ile Thr Ser Gly Asp Phe Leu Ala Leu Ala Ala			
	385	390	395	400
	acc ggc gca tac tgc tac gcc atg agc tcc cgc tac aac gcc ttc aca			1248
	Thr Gly Ala Tyr Cys Tyr Ala Met Ser Ser Arg Tyr Asn Ala Phe Thr			
	405	410	415	
	cgg ccc gcc gtc gtg tcc gtc cgc gct ggc agc tcc cgc ctc atg ctg			1296
	Arg Pro Ala Val Val Ser Val Arg Ala Gly Ser Ser Arg Leu Met Leu			
	420	425	430	
	cgc cgc gaa acg ctc gac gac atc ctc tca cta gag gca taa			1338
	Arg Arg Glu Thr Leu Asp Asp Ile Leu Ser Leu Glu Ala			
	435	440	445	

<210> 14

<211> 445

<212> PRT

<213> Corynebacterium glutamicum

<400> 14

Met Ala Thr Val Glu Asn Phe Asn Glu Leu Pro Ala His Val Trp Pro
 1 5 10 15
 Arg Asn Ala Val Arg Gln Glu Asp Gly Val Val Thr Val Ala Gly Val
 20 25 30
 Pro Leu Pro Asp Leu Ala Glu Glu Tyr Gly Thr Pro Leu Phe Val Val
 35 40 45
 Asp Glu Asp Asp Phe Arg Ser Arg Cys Arg Asp Met Ala Thr Ala Phe
 50 55 60
 Gly Gly Pro Gly Asn Val His Tyr Ala Ser Lys Ala Phe Leu Thr Lys
 65 70 75 80
 Thr Ile Ala Arg Trp Val Asp Glu Glu Gly Leu Ala Leu Asp Ile Ala
 85 90 95
 Ser Ile Asn Glu Leu Gly Ile Ala Leu Ala Ala Gly Phe Pro Ala Ser
 100 105 110
 Arg Ile Thr Ala His Gly Asn Asn Lys Gly Val Glu Phe Leu Arg Ala
 115 120 125
 Leu Val Gln Asn Gly Val Gly His Val Val Leu Asp Ser Ala Gln Glu
 130 135 140
 Leu Glu Leu Leu Asp Tyr Val Ala Ala Gly Glu Gly Lys Ile Gln Asp
 145 150 155 160
 Val Leu Ile Arg Val Lys Pro Gly Ile Glu Ala His Thr His Glu Phe
 165 170 175
 Ile Ala Thr Ser His Glu Asp Gln Lys Phe Gly Phe Ser Leu Ala Ser
 180 185 190
 Gly Ser Ala Phe Glu Ala Ala Lys Ala Ala Asn Asn Ala Glu Asn Leu
 195 200 205
 Asn Leu Val Gly Leu His Cys His Val Gly Ser Gln Val Phe Asp Ala
 210 215 220
 Glu Gly Phe Lys Leu Ala Ala Glu Arg Val Leu Gly Leu Tyr Ser Gln
 225 230 235 240
 Ile His Ser Glu Leu Gly Val Ala Leu Pro Glu Leu Asp Leu Gly Gly
 245 250 255

Gly Tyr Gly Ile Ala Tyr Thr Ala Ala Glu Glu Pro Leu Asn Val Ala
 260 265 270
 Glu Val Ala Ser Asp Leu Leu Thr Ala Val Gly Lys Met Ala Ala Glu
 275 280 285
 Leu Gly Ile Asp Ala Pro Thr Val Leu Val Glu Pro Gly Arg Ala Ile
 290 295 300
 Ala Gly Pro Ser Thr Val Thr Ile Tyr Glu Val Gly Thr Thr Lys Asp
 305 310 315 320
 Val His Val Asp Asp Asp Lys Thr Arg Arg Tyr Ile Ala Val Asp Gly
 325 330 335
 Gly Met Ser Asp Asn Ile Arg Pro Ala Leu Tyr Gly Ser Glu Tyr Asp
 340 345 350
 Ala Arg Val Val Ser Arg Phe Ala Glu Gly Asp Pro Val Ser Thr Arg
 355 360 365
 Ile Val Gly Ser His Cys Glu Ser Gly Asp Ile Leu Ile Asn Asp Glu
 370 375 380
 Ile Tyr Pro Ser Asp Ile Thr Ser Gly Asp Phe Leu Ala Leu Ala Ala
 385 390 395 400
 Thr Gly Ala Tyr Cys Tyr Ala Met Ser Ser Arg Tyr Asn Ala Phe Thr
 405 410 415
 Arg Pro Ala Val Val Ser Val Arg Ala Gly Ser Ser Arg Leu Met Leu
 420 425 430
 Arg Arg Glu Thr Leu Asp Asp Ile Leu Ser Leu Glu Ala
 435 440 445

<210> 15

<211> 753

<212> DNA

<213> *Corynebacterium glutamicum*

<220>

<221> CDS

<222> (1)..(753)

<400> 15

gtg	gcc	gaa	caa	gtt	aaa	ttg	agc	gtg	gag	ttg	ata	gcg	tgc	agt	tct	48
Met	Ala	Glu	Gln	Val	Lys	Leu	Ser	Val	Glu	Leu	Ile	Ala	Cys	Ser	Ser	
1				5					10					15		

ttt	act	cca	ccc	gct	gat	gtt	gag	tgg	tca	act	gat	gtt	gag	ggc	gcg	96
Phe	Thr	Pro	Pro	Ala	Asp	Val	Glu	Trp	Ser	Thr	Asp	Val	Glu	Gly	Ala	
			20					25					30			

gaa	gca	ctc	gtc	gag	ttt	gcg	ggg	cgt	gcc	tgc	tac	gaa	act	ttt	gat	144
Glu	Ala	Leu	Val	Glu	Phe	Ala	Gly	Arg	Ala	Cys	Tyr	Glu	Thr	Phe	Asp	
		35					40					45				

aag	ccg	aac	cct	cga	act	gct	tcc	aat	gct	gcg	tat	ctg	cgc	cac	atc	192
Lys	Pro	Asn	Pro	Arg	Thr	Ala	Ser	Asn	Ala	Ala	Tyr	Leu	Arg	His	Ile	
	50					55					60					

atg	gaa	gtg	ggg	cac	act	gct	ttg	ctt	gag	cat	gcc	aat	gcc	acg	atg	240
Met	Glu	Val	Gly	His	Thr	Ala	Leu	Leu	Glu	His	Ala	Asn	Ala	Thr	Met	
65					70					75					80	

tat	atc	cga	ggc	att	tct	cgg	tcc	gcg	acc	cat	gaa	ttg	gtc	cga	cac	288
Tyr	Ile	Arg	Gly	Ile	Ser	Arg	Ser	Ala	Thr	His	Glu	Leu	Val	Arg	His	
			85						90					95		

cgc	cat	ttt	tcc	ttc	tct	caa	ctg	tct	cag	cgt	ttc	gtg	cac	agc	gga	336
Arg	His	Phe	Ser	Phe	Ser	Gln	Leu	Ser	Gln	Arg	Phe	Val	His	Ser	Gly	
			100					105					110			

gaa	tcg	gaa	gta	gtg	gtg	ccc	act	ctc	atc	gat	gaa	gat	ccg	cag	ttg	384
Glu	Ser	Glu	Val	Val	Val	Pro	Thr	Leu	Ile	Asp	Glu	Asp	Pro	Gln	Leu	
		115					120					125				

cgt	gaa	ctt	ttc	atg	cac	gcc	atg	gat	gag	tct	cgg	ttc	gct	ttc	aat	432
Arg	Glu	Leu	Phe	Met	His	Ala	Met	Asp	Glu	Ser	Arg	Phe	Ala	Phe	Asn	
	130					135					140					

gag	ctg	ctt	aat	gcg	ctg	gaa	gaa	aaa	ctt	ggc	gat	gaa	ccg	aat	gca	480
Glu	Leu	Leu	Asn	Ala	Leu	Glu	Glu	Lys	Leu	Gly	Asp	Glu	Pro	Asn	Ala	
145				150						155					160	

ctt	tta	agg	aaa	aag	cag	gct	cgt	caa	gca	gct	cgc	gct	gtg	ctg	ccc	528
Leu	Leu	Arg	Lys	Lys	Gln	Ala	Arg	Gln	Ala	Ala	Arg	Ala	Val	Leu	Pro	
			165					170						175		

aac	gct	aca	gag	tcc	aga	atc	gtg	gtg	tct	gga	aac	ttc	cgc	acc	tgg	576
Asn	Ala	Thr	Glu	Ser	Arg	Ile	Val	Val	Ser	Gly	Asn	Phe	Arg	Thr	Trp	
			180				185						190			

agg	cat	ttc	att	ggc	atg	cga	gcc	agt	gaa	cat	gca	gac	gtc	gaa	atc	624
Arg	His	Phe	Ile	Gly	Met	Arg	Ala	Ser	Glu	His	Ala	Asp	Val	Glu	Ile	
		195					200					205				

cgc	gaa	gta	gcg	gta	gga	tgt	tta	aga	aag	ctg	cag	gta	gca	gcg	cca	672
Arg	Glu	Val	Ala	Val	Gly	Cys	Leu	Arg	Lys	Leu	Gln	Val	Ala	Ala	Pro	
	210					215					220					

act	gtt	ttc	ggg	gat	ttt	gag	att	gaa	act	ttg	gca	gac	gga	tcg	caa	720
Thr	Val	Phe	Gly	Asp	Phe	Glu	Ile	Glu	Thr	Leu	Ala	Asp	Gly	Ser	Gln	

225		230		235		240	
atg gca aca agc ccg tat gtc atg gac ttt taa							753
Met Ala Thr Ser Pro Tyr Val Met Asp Phe							
		245		250			

<210> 16

<211> 250

<212> PRT

<213> Corynebacterium glutamicum

<400> 16

Met	Ala	Glu	Gln	Val	Lys	Leu	Ser	Val	Glu	Leu	Ile	Ala	Cys	Ser	Ser
1				5					10					15	

Phe	Thr	Pro	Pro	Ala	Asp	Val	Glu	Trp	Ser	Thr	Asp	Val	Glu	Gly	Ala
			20					25					30		

Glu	Ala	Leu	Val	Glu	Phe	Ala	Gly	Arg	Ala	Cys	Tyr	Glu	Thr	Phe	Asp
		35					40					45			

Lys	Pro	Asn	Pro	Arg	Thr	Ala	Ser	Asn	Ala	Ala	Tyr	Leu	Arg	His	Ile
	50					55					60				

Met	Glu	Val	Gly	His	Thr	Ala	Leu	Leu	Glu	His	Ala	Asn	Ala	Thr	Met
65					70					75					80

Tyr	Ile	Arg	Gly	Ile	Ser	Arg	Ser	Ala	Thr	His	Glu	Leu	Val	Arg	His
				85					90					95	

Arg	His	Phe	Ser	Phe	Ser	Gln	Leu	Ser	Gln	Arg	Phe	Val	His	Ser	Gly
			100					105					110		

Glu	Ser	Glu	Val	Val	Val	Pro	Thr	Leu	Ile	Asp	Glu	Asp	Pro	Gln	Leu
		115						120				125			

Arg	Glu	Leu	Phe	Met	His	Ala	Met	Asp	Glu	Ser	Arg	Phe	Ala	Phe	Asn
	130					135					140				

Glu	Leu	Leu	Asn	Ala	Leu	Glu	Glu	Lys	Leu	Gly	Asp	Glu	Pro	Asn	Ala
145					150					155					160

Leu	Leu	Arg	Lys	Lys	Gln	Ala	Arg	Gln	Ala	Ala	Arg	Ala	Val	Leu	Pro
				165					170					175	

Asn Ala Thr Glu Ser Arg Ile Val Val Ser Gly Asn Phe Arg Thr Trp
 180 185 190
 Arg His Phe Ile Gly Met Arg Ala Ser Glu His Ala Asp Val Glu Ile
 195 200 205
 Arg Glu Val Ala Val Gly Cys Leu Arg Lys Leu Gln Val Ala Ala Pro
 210 215 220
 Thr Val Phe Gly Asp Phe Glu Ile Glu Thr Leu Ala Asp Gly Ser Gln
 225 230 235 240
 Met Ala Thr Ser Pro Tyr Val Met Asp Phe
 245 250

<210> 17

<211> 551

<212> DNA

<213> Corynebacterium glutamicum

<400> 17

aaccggtgtg gagccgacca ttccgcgagg ctgcactgca acgaggctcgt agttttggta	60
catggcttct ggccagttca tggattggct gccgaagaag ctataggcat cgccaccagg	120
gccaccggag ttaccgaaga tggtgccgtg cttttcgcct tgggcaggga ccttgacaaa	180
gcccacgctg atatcgccaa gtgagggatc agaatagtgc atgggcacgt cgatgctgcc	240
acattgagcg gaggcaatat ctacctgagg tgggcattct tcccagcgga tgttttcttg	300
cgctgctgca gtgggcattg ataccaaaaa ggggctaagc gcagtcgagg cggaagaac	360
tgctactacc ttttttattg tcgaacgggg cattacggct ccaaggacgt ttgttttctg	420
ggtcagttac cccaaaaagc atatacagag accaatgatt tttcattaaa aaggcaggga	480
tttgttataa gtatgggtcg tattctgtgc gacgggtgta cctcggctag aatttctccc	540
catgacacca g	551

<210> 18

<211> 365

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (1)..(365)

<400> 18

gtg gcc gaa caa gtt aaa ttg agc gtg gag ttg ata gcg tgc agt tct	48
Met Ala Glu Gln Val Lys Leu Ser Val Glu Leu Ile Ala Cys Ser Ser	
1 5 10 15	

ttt act cca ccc gct gat gtt gag tgg tca act gat gtt gag ggc gcg	96
Phe Thr Pro Pro Ala Asp Val Glu Trp Ser Thr Asp Val Glu Gly Ala	
20 25 30	

gaa gca ctc gtc gag ttt gcg ggt cgt gcc tgc tac gaa act ttt gat	144
Glu Ala Leu Val Glu Phe Ala Gly Arg Ala Cys Tyr Glu Thr Phe Asp	
35 40 45	

aag ccg aac cct cga act gct tcc aat gct gcg tat ctg cgc cac atc	192
Lys Pro Asn Pro Arg Thr Ala Ser Asn Ala Ala Tyr Leu Arg His Ile	
50 55 60	

atg gaa gtg ggg cac act gct ttg ctt gag cat gcc aat gcc acg atg	240
Met Glu Val Gly His Thr Ala Leu Leu Glu His Ala Asn Ala Thr Met	
65 70 75 80	

tat atc cga ggc att tct cgg tcc gcg acc cat gaa ttg gtc cga cac	288
Tyr Ile Arg Gly Ile Ser Arg Ser Ala Thr His Glu Leu Val Arg His	
85 90 95	

cgc cat ttt tcc ttc tct caa ctg tct cag cgt ttc gtg cac agc gga	336
Arg His Phe Ser Phe Ser Gln Leu Ser Gln Arg Phe Val His Ser Gly	
100 105 110	

gaa tcg gaa gta gtg gtg ccc act ctc at	365
Glu Ser Glu Val Val Val Pro Thr Leu	
115 120	

<210> 19

<211> 122

<212> PRT

<213> Corynebacterium glutamicum

<400> 19

Met Ala Glu Gln Val Lys Leu Ser Val Glu Leu Ile Ala Cys Ser Ser	
1 5 10 15	

Phe Thr Pro Pro Ala Asp Val Glu Trp Ser Thr Asp Val Glu Gly Ala	
20 25 30	

Glu Ala Leu Val Glu Phe Ala Gly Arg Ala Cys Tyr Glu Thr Phe Asp	
35 40 45	

Lys Pro Asn Pro Arg Thr Ala Ser Asn Ala Ala Tyr Leu Arg His Ile
50 55 60

Met Glu Val Gly His Thr Ala Leu Leu Glu His Ala Asn Ala Thr Met
65 70 75 80

Tyr Ile Arg Gly Ile Ser Arg Ser Ala Thr His Glu Leu Val Arg His
85 90 95

Arg His Phe Ser Phe Ser Gln Leu Ser Gln Arg Phe Val His Ser Gly
100 105 110

Glu Ser Glu Val Val Val Pro Thr Leu Ile
115 120

<210> 20

<211> 833

<212> DNA

<213> Corynebacterium glutamicum

<220>

<221> CDS

<222> (1)..(833)

<400> 20

atg gct aca gtt gaa aat ttc aat gaa ctt ccc gca cac gta tgg cca	48
Met Ala Thr Val Glu Asn Phe Asn Glu Leu Pro Ala His Val Trp Pro	
1 5 10 15	

cgc aat gca gtg cgc caa gaa gac ggc gtt gtc acc gtc gct ggt gtg	96
Arg Asn Ala Val Arg Gln Glu Asp Gly Val Val Thr Val Ala Gly Val	
20 25 30	

cct ctg cct gac ctc gct gaa gaa tac gga acc cca ctg ttc gta gtc	144
Pro Leu Pro Asp Leu Ala Glu Glu Tyr Gly Thr Pro Leu Phe Val Val	
35 40 45	

gac gag gac gat ttc cgt tcc cgc tgt cgc gac atg gct acc gca ttc	192
Asp Glu Asp Asp Phe Arg Ser Arg Cys Arg Asp Met Ala Thr Ala Phe	
50 55 60	

ggt gga cca ggc aat gtg cac tac gca tcc aaa gcg ttc ctg acc aag	240
Gly Gly Pro Gly Asn Val His Tyr Ala Ser Lys Ala Phe Leu Thr Lys	
65 70 75 80	

acc att gca cgt tgg gtt gat gaa gag ggg ctg gca ctg gac att gcg	288
Thr Ile Ala Arg Trp Val Asp Glu Glu Gly Leu Ala Leu Asp Ile Ala	
85 90 95	

tcc atc aat gaa ctg ggc att gcc ctg gcc gct ggt ttc ccg gcc agc Ser Ile Asn Glu Leu Gly Ile Ala Leu Ala Ala Gly Phe Pro Ala Ser 100 105 110	336
cgt atc acc gcg cac ggc aac aac aaa ggc gta gag ttc ctg cgc gcg Arg Ile Thr Ala His Gly Asn Asn Lys Gly Val Glu Phe Leu Arg Ala 115 120 125	384
ttg gtt caa aac ggt gtc ggg cat gtg gtg ctg gac tcc gcg cag gaa Leu Val Gln Asn Gly Val Gly His Val Val Leu Asp Ser Ala Gln Glu 130 135 140	432
ttg gaa ctg ctg gat tac gtt gcc gct ggt gaa ggc aag atc cag gac Leu Glu Leu Leu Asp Tyr Val Ala Ala Gly Glu Gly Lys Ile Gln Asp 145 150 155 160	480
gtg ttg atc cgc gtg aag cca ggt atc gaa gcc cac acc cac gag ttc Val Leu Ile Arg Val Lys Pro Gly Ile Glu Ala His Thr His Glu Phe 165 170 175	528
atc gcc act agc cac gaa gac cag aag ttc gga ttc tcc ctg gca tcc Ile Ala Thr Ser His Glu Asp Gln Lys Phe Gly Phe Ser Leu Ala Ser 180 185 190	576
ggt tcc gca ttc gaa gca gcg aaa gca gcc aac aat gca gag aac ttg Gly Ser Ala Phe Glu Ala Ala Lys Ala Ala Asn Asn Ala Glu Asn Leu 195 200 205	624
aac ctg gtt ggt ctg cac tgc cat gtt ggt tcc cag gtg ttc gac gcc Asn Leu Val Gly Leu His Cys His Val Gly Ser Gln Val Phe Asp Ala 210 215 220	672
gaa ggc ttc aag ctg gca gca gag cgc gtg ttg ggc ctg tac tca cag Glu Gly Phe Lys Leu Ala Ala Glu Arg Val Leu Gly Leu Tyr Ser Gln 225 230 235 240	720
atc cac agc gaa cta ggt gtc gcc ctt cct gag ctg gac ctc ggt ggc Ile His Ser Glu Leu Gly Val Ala Leu Pro Glu Leu Asp Leu Gly Gly 245 250 255	768
gga tac ggc atc gcc tac act gca gat gag gaa cca ctc aac gtc gca Gly Tyr Gly Ile Ala Tyr Thr Ala Asp Glu Glu Pro Leu Asn Val Ala 260 265 270	816
gaa gtc gcc tcc gac ct Glu Val Ala Ser Asp Leu 275	833

<210> 21

<211> 278

<212> PRT

<213> Corynebacterium glutamicum

<400> 21

Met Ala Thr Val Glu Asn Phe Asn Glu Leu Pro Ala His Val Trp Pro 1 5 10 15
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Arg	Asn	Ala	Val	Arg	Gln	Glu	Asp	Gly	Val	Val	Thr	Val	Ala	Gly	Val
			20					25					30		
Pro	Leu	Pro	Asp	Leu	Ala	Glu	Glu	Tyr	Gly	Thr	Pro	Leu	Phe	Val	Val
		35					40					45			
Asp	Glu	Asp	Asp	Phe	Arg	Ser	Arg	Cys	Arg	Asp	Met	Ala	Thr	Ala	Phe
	50					55					60				
Gly	Gly	Pro	Gly	Asn	Val	His	Tyr	Ala	Ser	Lys	Ala	Phe	Leu	Thr	Lys
65				70						75					80
Thr	Ile	Ala	Arg	Trp	Val	Asp	Glu	Glu	Gly	Leu	Ala	Leu	Asp	Ile	Ala
				85					90					95	
Ser	Ile	Asn	Glu	Leu	Gly	Ile	Ala	Leu	Ala	Ala	Gly	Phe	Pro	Ala	Ser
			100					105					110		
Arg	Ile	Thr	Ala	His	Gly	Asn	Asn	Lys	Gly	Val	Glu	Phe	Leu	Arg	Ala
		115					120					125			
Leu	Val	Gln	Asn	Gly	Val	Gly	His	Val	Val	Leu	Asp	Ser	Ala	Gln	Glu
	130					135					140				
Leu	Glu	Leu	Leu	Asp	Tyr	Val	Ala	Ala	Gly	Glu	Gly	Lys	Ile	Gln	Asp
145					150					155					160
Val	Leu	Ile	Arg	Val	Lys	Pro	Gly	Ile	Glu	Ala	His	Thr	His	Glu	Phe
				165					170					175	
Ile	Ala	Thr	Ser	His	Glu	Asp	Gln	Lys	Phe	Gly	Phe	Ser	Leu	Ala	Ser
			180					185					190		
Gly	Ser	Ala	Phe	Glu	Ala	Ala	Lys	Ala	Ala	Asn	Asn	Ala	Glu	Asn	Leu
		195					200					205			
Asn	Leu	Val	Gly	Leu	His	Cys	His	Val	Gly	Ser	Gln	Val	Phe	Asp	Ala
	210					215					220				
Glu	Gly	Phe	Lys	Leu	Ala	Ala	Glu	Arg	Val	Leu	Gly	Leu	Tyr	Ser	Gln
225					230					235					240
Ile	His	Ser	Glu	Leu	Gly	Val	Ala	Leu	Pro	Glu	Leu	Asp	Leu	Gly	Gly
				245					250					255	
Gly	Tyr	Gly	Ile	Ala	Tyr	Thr	Ala	Asp	Glu	Glu	Pro	Leu	Asn	Val	Ala
			260					265					270		

Glu Val Ala Ser Asp Leu
275

<210> 22

<211> 28

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 22
gggtacctcg cgaagtagca cctgtcac

28

<210> 23

<211> 26

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 23
gcggatcccc catcgcccct caaaga

26

<210> 24

<211> 21

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 24
aacgggcggt gaagggaac t

21

<210> 25

<211> 21

<212> DNA
 <213> Artificial

 <220>
 <223> Primer
 <400> 25
 tgaaagacag gggatatccag a 21

 <210> 26
 <211> 24
 <212> DNA
 <213> Artificial

 <220>
 <223> Primer
 <400> 26
 ccatggtacc aagtgcgtgg cgag 24

 <210> 27
 <211> 25
 <212> DNA
 <213> Artificial

 <220>
 <223> Primer
 <400> 27
 ccatggtacc acactgtttc cttgc 25

 <210> 28
 <211> 36
 <212> DNA
 <213> Artificial

 <220>
 <223> Primer

<400> 28
ctgggtccgg cgagtggagc cgaccattcc gcgagg 36

<210> 29

<211> 36

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 29
ctcgctccgg cgaggtcgga ggcaacttct gcgacg 36

<210> 30

<211> 6

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 30
ggtacc 6

<210> 31

<211> 18

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 31
ggatcttcac ctagatcc 18

<210> 32

<211> 16

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 32
ccctgataaa tgcttc

16

<210> 33

<211> 25

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 33
ccggagaaga tgtaacaatg gctac

25

<210> 34

<211> 25

<212> DNA

<213> Artificial

<220>

<223> Primer

<400> 34
cctcgactgc agaccctag acacc

25

<210> 35

<211> 421

<212> PRT

<213> Corynebacterium glutamicum

<400> 35

Met Ala Leu Val Val Gln Lys Tyr Gly Gly Ser Ser Leu Glu Ser Ala
1 5 10 15

Glu	Arg	Ile	Arg	Asn	Val	Ala	Glu	Arg	Ile	Val	Ala	Thr	Lys	Lys	Ala
			20					25					30		
Gly	Asn	Asp	Val	Val	Val	Val	Val	Ser	Ala	Met	Gly	Asp	Thr	Thr	Asp
		35					40					45			
Glu	Leu	Leu	Glu	Leu	Ala	Ala	Ala	Val	Asn	Pro	Val	Pro	Pro	Ala	Arg
	50					55					60				
Glu	Met	Asp	Met	Leu	Leu	Thr	Ala	Gly	Glu	Arg	Ile	Ser	Asn	Ala	Leu
65					70					75					80
Val	Ala	Met	Ala	Ile	Glu	Ser	Leu	Gly	Ala	Glu	Ala	Gln	Ser	Phe	Thr
				85					90					95	
Gly	Ser	Gln	Ala	Gly	Val	Leu	Thr	Thr	Glu	Arg	His	Gly	Asn	Ala	Arg
			100					105					110		
Ile	Val	Asp	Val	Thr	Pro	Gly	Arg	Val	Arg	Glu	Ala	Leu	Asp	Glu	Gly
		115					120					125			
Lys	Ile	Cys	Ile	Val	Ala	Gly	Phe	Gln	Gly	Val	Asn	Lys	Glu	Thr	Arg
	130					135					140				
Asp	Val	Thr	Thr	Leu	Gly	Arg	Gly	Gly	Ser	Asp	Thr	Thr	Ala	Val	Ala
145					150					155					160
Leu	Ala	Ala	Ala	Leu	Asn	Ala	Asp	Val	Cys	Glu	Ile	Tyr	Ser	Asp	Val
				165					170					175	
Asp	Gly	Val	Tyr	Thr	Ala	Asp	Pro	Arg	Ile	Val	Pro	Asn	Ala	Gln	Lys
			180					185					190		
Leu	Glu	Lys	Leu	Ser	Phe	Glu	Glu	Met	Leu	Glu	Leu	Ala	Ala	Val	Gly
		195					200					205			
Ser	Lys	Ile	Leu	Val	Leu	Arg	Ser	Val	Glu	Tyr	Ala	Arg	Ala	Phe	Asn
	210					215					220				
Val	Pro	Leu	Arg	Val	Arg	Ser	Ser	Tyr	Ser	Asn	Asp	Pro	Gly	Thr	Leu
225					230					235					240
Ile	Ala	Gly	Ser	Met	Glu	Asp	Ile	Pro	Val	Glu	Glu	Ala	Val	Leu	Thr
				245					250					255	
Gly	Val	Ala	Thr	Asp	Lys	Ser	Glu	Ala	Lys	Val	Thr	Val	Leu	Gly	Ile
			260					265					270		

Ser Asp Lys Pro Gly Glu Ala Ala Lys Val Phe Arg Ala Leu Ala Asp
 275 280 285
 Ala Glu Ile Asn Ile Asp Met Val Leu Gln Asn Val Ser Ser Val Glu
 290 295 300
 Asp Gly Thr Thr Asp Ile Thr Phe Thr Cys Pro Arg Ser Asp Gly Arg
 305 310 315 320
 Arg Ala Met Glu Ile Leu Lys Lys Leu Gln Val Gln Gly Asn Trp Thr
 325 330 335
 Asn Val Leu Tyr Asp Asp Gln Val Gly Lys Val Ser Leu Val Gly Ala
 340 345 350
 Gly Met Lys Ser His Pro Gly Val Thr Ala Glu Phe Met Glu Ala Leu
 355 360 365
 Arg Asp Val Asn Val Asn Ile Glu Leu Ile Ser Thr Ser Glu Ile Arg
 370 375 380
 Ile Ser Val Leu Ile Arg Glu Asp Asp Leu Asp Ala Ala Ala Arg Ala
 385 390 395 400
 Leu His Glu Gln Phe Gln Leu Gly Gly Glu Asp Glu Ala Val Val Tyr
 405 410 415
 Ala Gly Thr Gly Arg
 420

<210> 36

<211> 421

<212> PRT

<213> Corynebacterium glutamicum

<400> 36

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 Glu Arg Ile Arg Asn Val Ala Glu Arg Ile Val Ala Thr Lys Lys Ala
 20 25 30
 Gly Asn Asp Val Val Val Val Cys Ser Ala Met Gly Asp Thr Thr Asp
 35 40 45

Glu Leu Leu Glu Leu Ala Ala Ala Val Asn Pro Val Pro Pro Ala Arg
 50 55 60

Glu Met Asp Met Leu Leu Thr Ala Gly Glu Arg Ile Ser Asn Ala Leu
 65 70 75 80

Val Ala Met Ala Ile Glu Ser Leu Gly Ala Glu Ala Gln Ser Phe Thr
 85 90 95

Gly Ser Gln Ala Gly Val Leu Thr Thr Glu Arg His Gly Asn Ala Arg
 100 105 110

Ile Val Asp Val Thr Pro Gly Arg Val Arg Glu Ala Leu Asp Glu Gly
 115 120 125

Lys Ile Cys Ile Val Ala Gly Phe Gln Gly Val Asn Lys Glu Thr Arg
 130 135 140

Asp Val Thr Thr Leu Gly Arg Gly Gly Ser Asp Thr Thr Ala Val Ala
 145 150 155 160

Leu Ala Ala Ala Leu Asn Ala Asp Val Cys Glu Ile Tyr Ser Asp Val
 165 170 175

Asp Gly Val Tyr Thr Ala Asp Pro Arg Ile Val Pro Asn Ala Gln Lys
 180 185 190

Leu Glu Lys Leu Ser Phe Glu Glu Met Leu Glu Leu Ala Ala Val Gly
 195 200 205

Ser Lys Ile Leu Val Leu Arg Ser Val Glu Tyr Ala Arg Ala Phe Asn
 210 215 220

Val Pro Leu Arg Val Arg Ser Ser Tyr Ser Asn Asp Pro Gly Thr Leu
 225 230 235 240

Ile Ala Gly Ser Met Glu Asp Ile Pro Val Glu Glu Ala Val Leu Thr
 245 250 255

Gly Val Ala Thr Asp Lys Ser Glu Ala Lys Val Thr Val Leu Gly Ile
 260 265 270

Ser Asp Lys Pro Gly Glu Ala Ala Lys Val Phe Arg Ala Leu Ala Asp
 275 280 285

Ala Glu Ile Asn Ile Asp Met Val Leu Gln Asn Val Ser Ser Val Glu
 290 295 300

Asp Gly Thr Thr Asp Ile Thr Phe Thr Cys Pro Arg Ala Asp Gly Arg
305 310 315 320

Arg Ala Met Glu Ile Leu Lys Lys Leu Gln Val Gln Gly Asn Trp Thr
325 330 335

Asn Val Leu Tyr Asp Asp Gln Val Asp Lys Val Ser Leu Val Gly Ala
340 345 350

Gly Met Lys Ser His Pro Gly Val Thr Ala Glu Phe Met Glu Ala Leu
355 360 365

Arg Asp Val Asn Val Asn Ile Glu Leu Ile Ser Thr Ser Glu Ile Arg
370 375 380

Ile Ser Val Leu Ile Arg Glu Asp Asp Leu Asp Ala Ala Ala Arg Ala
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Leu His Glu Gln Phe Gln Leu Gly Gly Glu Asp Glu Ala Val Val Tyr
405 410 415

Ala Gly Thr Gly Arg
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<210> 37

<211> 421

<212> PRT

<213> Corynebacterium glutamicum

<400> 37

Met Ala Leu Val Val Gln Lys Tyr Gly Gly Ser Ser Leu Glu Ser Ala
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Glu Arg Ile Arg Asn Val Ala Glu Arg Ile Val Ala Thr Lys Lys Ala
20 25 30

Gly Asn Asp Val Val Val Val Cys Ser Ala Met Gly Asp Thr Thr Asp
35 40 45

Glu Leu Leu Glu Leu Ala Ala Ala Val Asn Pro Val Pro Pro Ala Arg
50 55 60

Glu Met Asp Met Leu Leu Thr Ala Gly Glu Arg Ile Ser Asn Ala Leu
65 70 75 80

Val	Ala	Met	Ala	Ile	Glu	Ser	Leu	Gly	Ala	Glu	Ala	Gln	Ser	Phe	Thr	
				85					90					95		
Gly	Ser	Gln	Ala	Gly	Val	Leu	Thr	Thr	Glu	Arg	His	Gly	Asn	Ala	Arg	
			100					105					110			
Ile	Val	Asp	Val	Thr	Pro	Gly	Arg	Val	Arg	Glu	Ala	Leu	Asp	Glu	Gly	
		115					120					125				
Lys	Ile	Cys	Ile	Val	Ala	Gly	Phe	Gln	Gly	Val	Asn	Lys	Glu	Thr	Arg	
	130					135					140					
Asp	Val	Thr	Thr	Leu	Gly	Arg	Gly	Gly	Ser	Asp	Thr	Thr	Ala	Val	Ala	
145					150					155					160	
Leu	Ala	Ala	Ala	Leu	Asn	Ala	Asp	Val	Cys	Glu	Ile	Tyr	Ser	Asp	Val	
				165					170					175		
Asp	Gly	Val	Tyr	Thr	Ala	Asp	Pro	Arg	Ile	Val	Pro	Asn	Ala	Gln	Lys	
			180					185					190			
Leu	Glu	Lys	Leu	Ser	Phe	Glu	Glu	Met	Leu	Glu	Leu	Ala	Ala	Val	Gly	
		195					200					205				
Ser	Lys	Ile	Leu	Val	Leu	Arg	Ser	Val	Glu	Tyr	Ala	Arg	Ala	Phe	Asn	
	210					215					220					
Val	Pro	Leu	Arg	Val	Arg	Ser	Ser	Tyr	Ser	Asn	Asp	Pro	Gly	Thr	Leu	
225					230					235					240	
Ile	Ala	Gly	Ser	Met	Glu	Asp	Ile	Pro	Val	Glu	Glu	Ala	Val	Leu	Thr	
				245					250					255		
Gly	Val	Ala	Thr	Asp	Lys	Ser	Glu	Ala	Lys	Val	Thr	Val	Leu	Gly	Ile	
			260					265					270			
Ser	Asp	Lys	Pro	Gly	Glu	Ala	Ala	Lys	Val	Phe	Arg	Ala	Leu	Ala	Asp	
		275					280					285				
Ala	Glu	Ile	Asn	Ile	Asp	Met	Val	Leu	Gln	Asn	Val	Ser	Ser	Val	Glu	
	290					295					300					
Asp	Gly	Thr	Thr	Asp	Ile	Thr	Phe	Thr	Cys	Pro	Arg	Ala	Asp	Gly	Arg	
305					310					315					320	
Arg	Ala	Met	Glu	Ile	Leu	Lys	Lys	Leu	Gln	Val	Gln	Gly	Asn	Trp	Thr	
				325					330					335		

Asn Val Leu Tyr Asp Asp Gln Val Gly Lys Val Ser Leu Val Gly Ala
340 345 350

Gly Met Lys Ser His Pro Gly Val Thr Ala Glu Phe Met Glu Ala Leu
355 360 365

Arg Asp Val Asn Val Asn Ile Glu Leu Ile Ser Thr Ser Glu Ile Arg
370 375 380

Ile Ser Val Leu Ile Arg Glu Asp Asp Leu Asp Ala Ala Ala Arg Ala
385 390 395 400

Leu His Glu Gln Phe Gln Leu Gly Gly Glu Asp Glu Ala Val Val Tyr
405 410 415

Ala Gly Thr Gly Arg
420